



Armed Forces College of Medicine

AFCM



Viral Upper Respiratory tract infections

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INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

1. Describe the structure of viruses causing URTIs
2. Describe pathogenesis and clinical manifestations of viral URTIs
2. Outline laboratory diagnosis viral URTIs
3. Outline prevention and control of viral URTIs

Respiratory Tract



THE UPPER RESPIRATORY TRACT

Nose

Sinuses

Mouth

Pharynx

Larynx

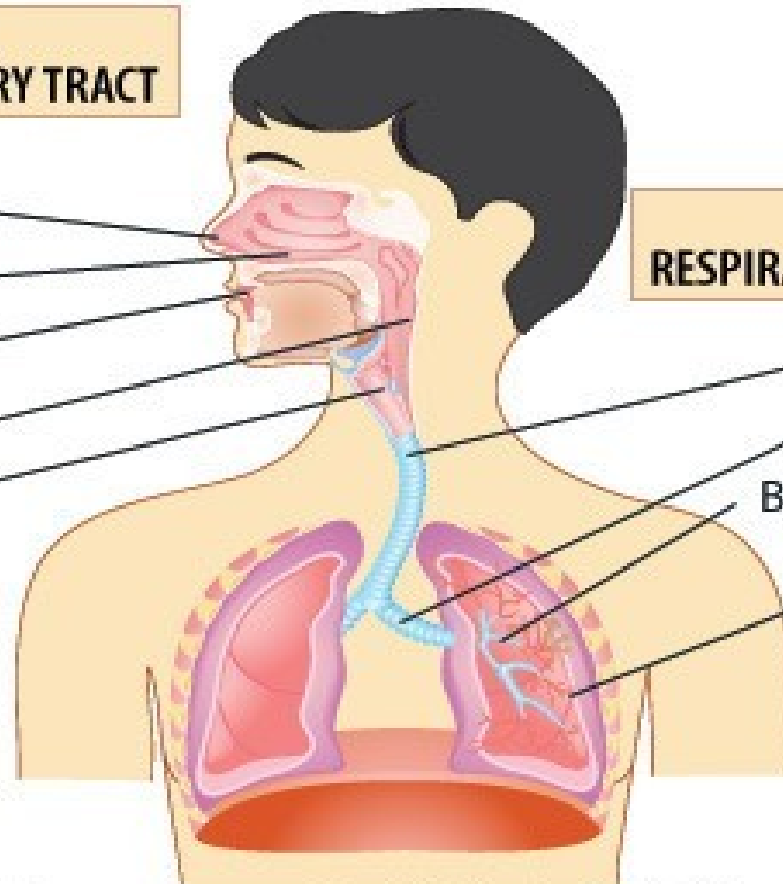
THE LOWER RESPIRATORY TRACT

Trachea

Bronchi

Bronchioles

Lungs



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Respiratory Tract Infections

Upper respiratory tract Diseases

Common Cold **Pharyngitis**

Otitis Media

Sinusitis

Laryngitis

Epiglottitis

Upper and Lower respiratory Tract Diseases

Croup

Influenza

Whooping Cough

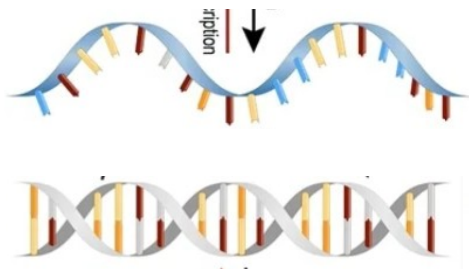
Lower Respiratory Tract Diseases

Bronchitis **Bronchiolitis** **Pneumonia**

Pulmonary TB

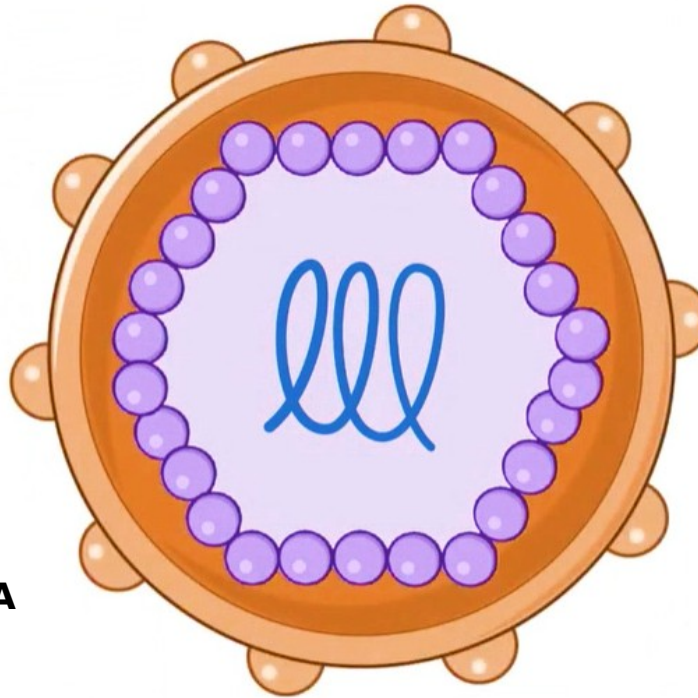
Lung abscess

Structure of Viruses



RNA

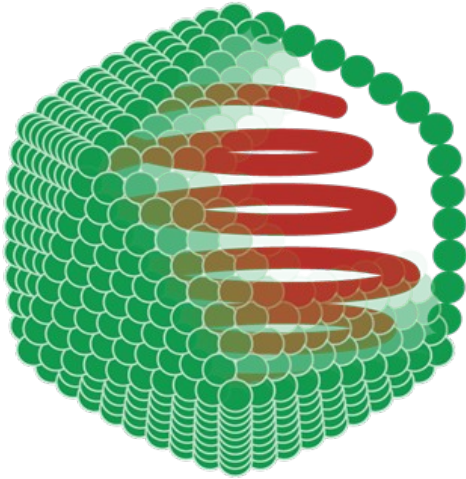
DNA



Classification of viruses

According to genome/ Envelope	
DNA Viruses	RNA Viruses
■ Enveloped	■ Enveloped
■ Non enveloped	■ Non enveloped

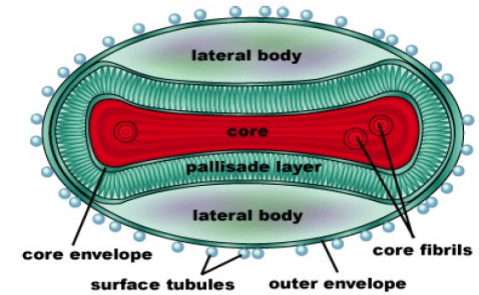
Shape (Symmetry) of viruses



**All DNA
viruses
except Pox**



**Most
Enveloped
RNA viruses**



Pox viruses

Protective immunity against microbes



Rules of defense against microbes

1-Innate immunity

early response

2-Adaptive immunity

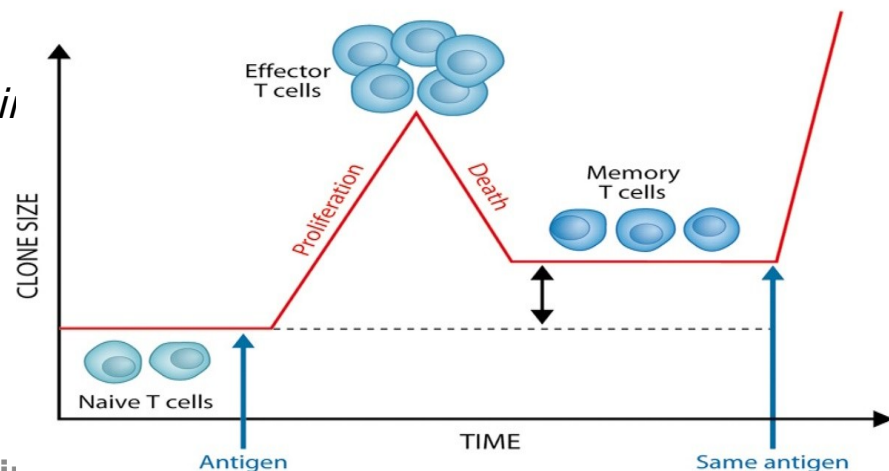
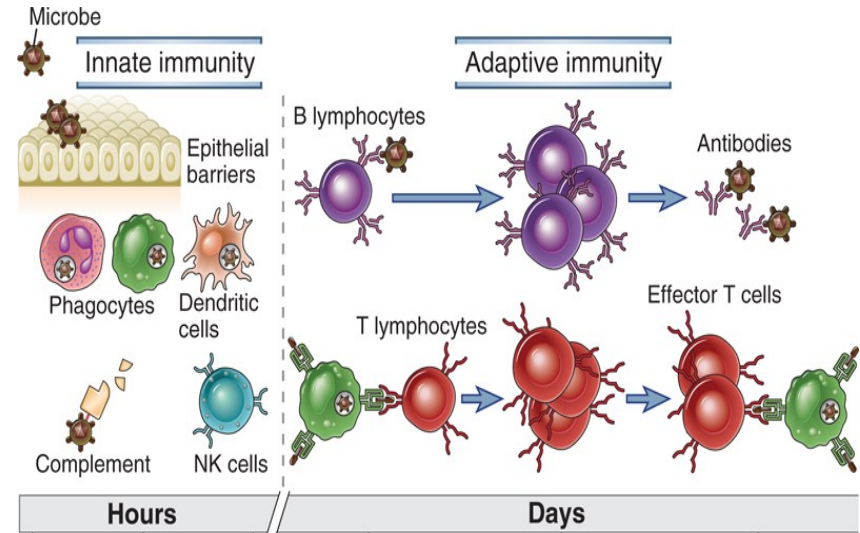
a. **Effector cells** → Eliminate microbes

i. **CMI** : Th1, & Cytotoxic T lymphocytes

ii. **Humoral immunity** : plasma cells producing

b. **Memory cells**

Protect from subsequent infections



Type I Interferon (IFN) : IFN α and β

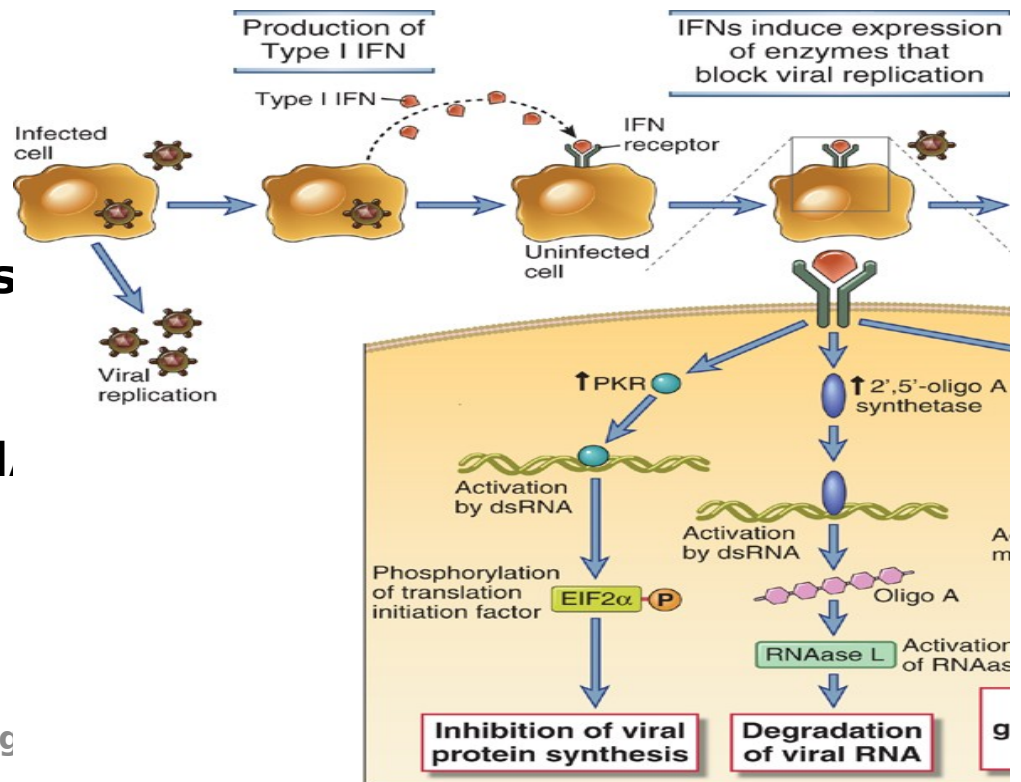
🕒 **virus replication** in non infected cells :

Antiviral state

i. \downarrow viral protein synthesis

ii. Degradation of viral RNA

Immunolog

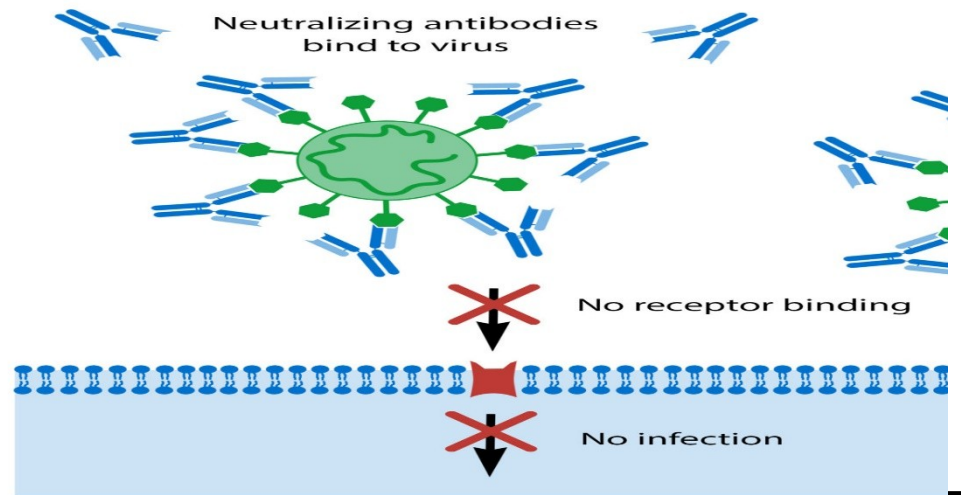


5 Classes of Igs (Abs)

IgM , A, G, E ,D

Neutralization

- Secretory IgA in mucos
- IgG in blood

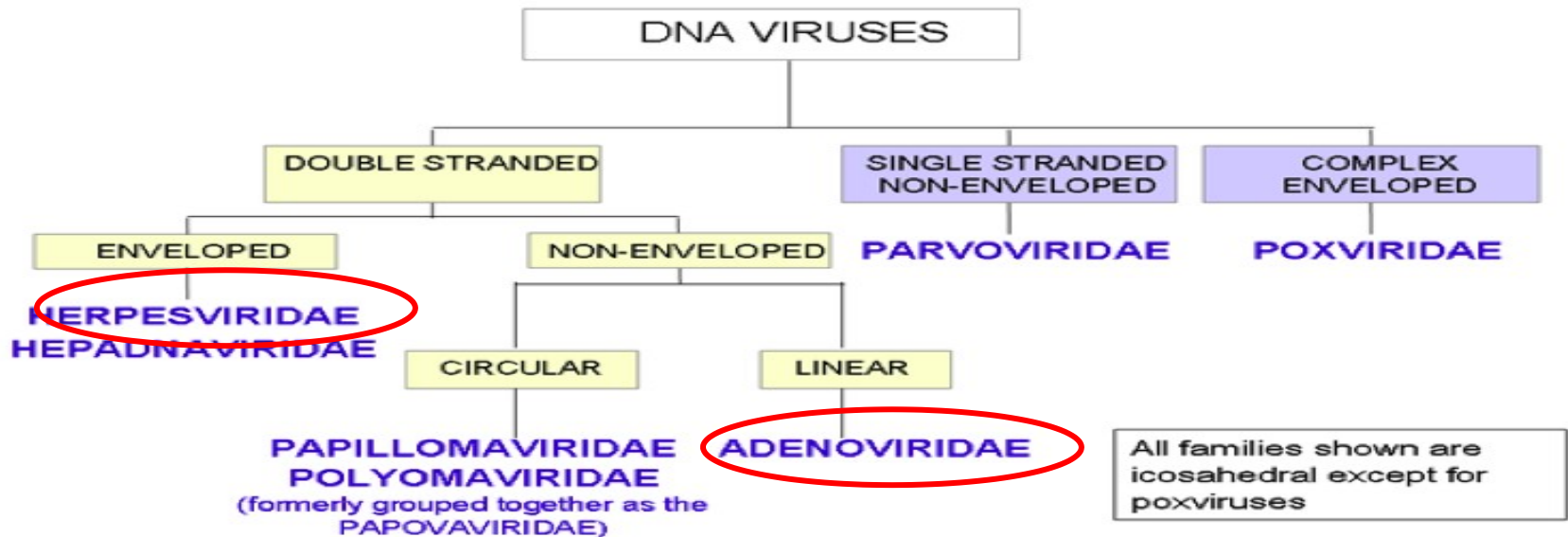
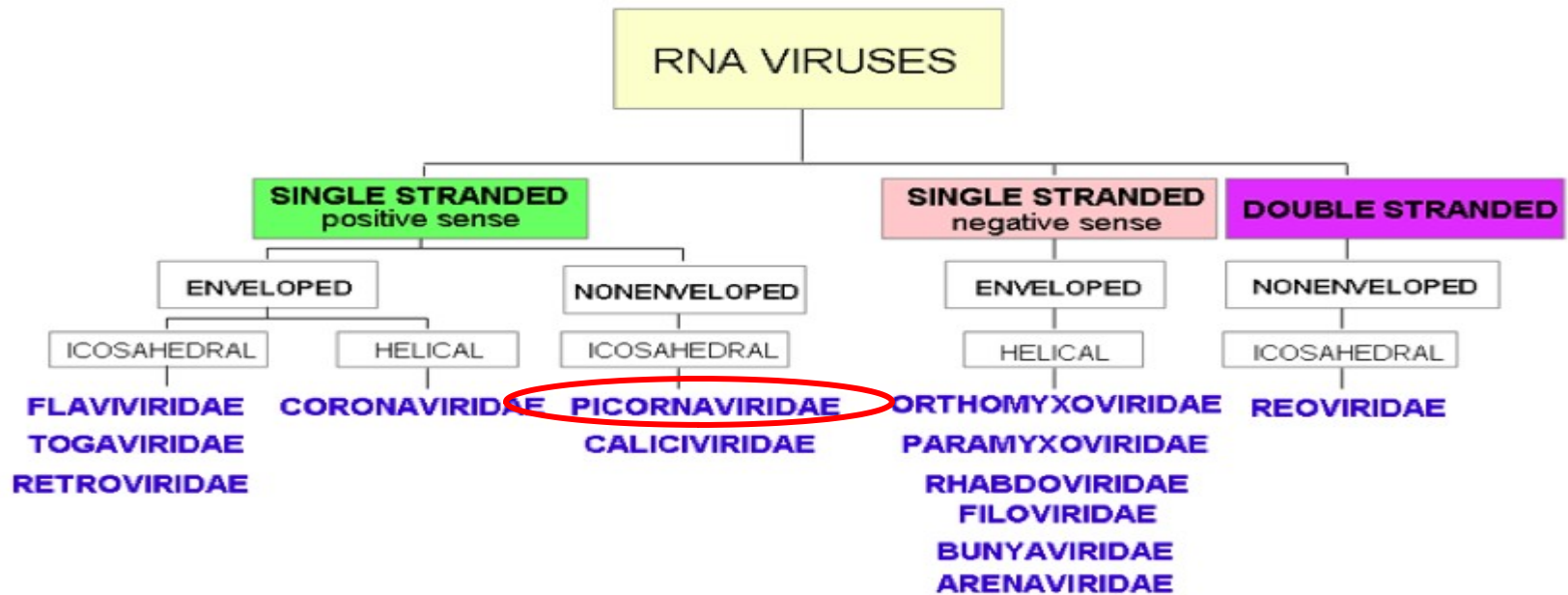


Pathogenesis of Viral Diseases



Types of viral diseases

Systemic infections	Local infections	
Polio viruses enter through GIT Blood CNS	Rhino viruses enter through RT & causes common cold	Example
At distant sites	At portal of entry	Site of pathology
Long	Short	Incubation period
Present	Absent	Viremia
Usually life-long	Usually short	Duration of immunity
IgM & IgG	Secretory IgA	Main Immunoglobulin involved



All families shown are icosahedral except for poxviruses

I - COMMON COLD



Definition

Viral infection of upper RT including some or all of the following structures :

Nose, throat, sinuses, eustachian tube

1 - Rhinoviruses (> 100 serotypes)

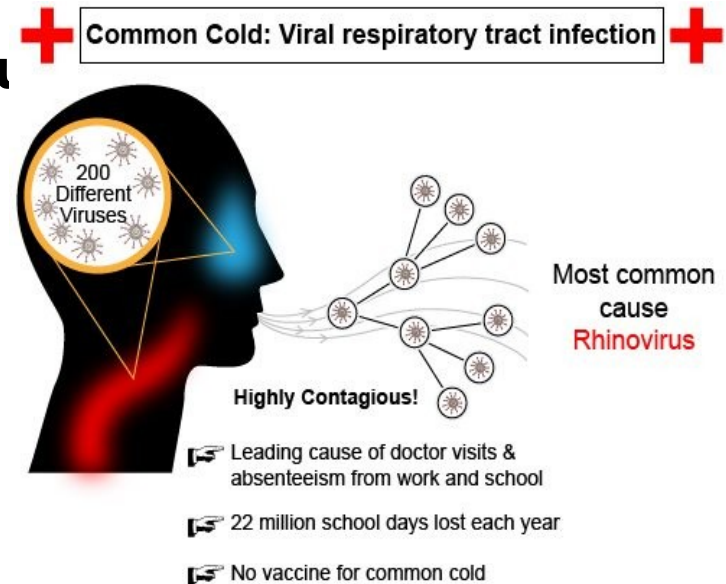
Most common cause (50%)

2 - Corona viruses

3 - Others :

a-Adenoviruses

b-Parainfluenza viruses.



Reinfections are common (Common cold is the most common human infection) Why?

Due to **multiplicity** of causative viruses &

antigenic diversity of rhinoviruses with no cross protection

I - COMMON COLD



Clinical Manifestations

- Cough, sneezing
- **Rhinorrhea** (watery nasal discharge without p
- No fever

Complications

2ry bacterial infection:

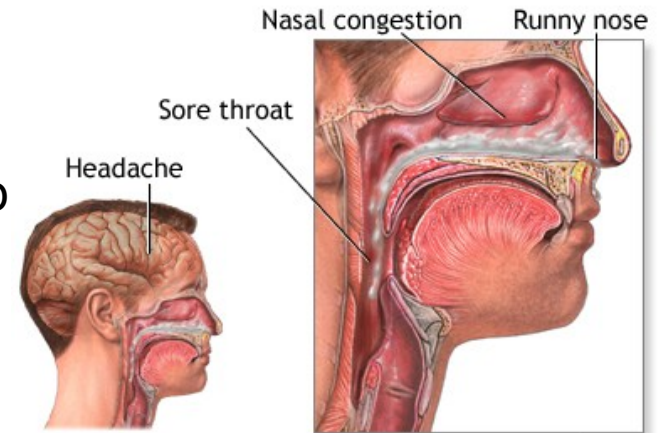


Sinusitis/ Otitis media / Tracheobronchitis

Lab. Diagnosis : usually not needed

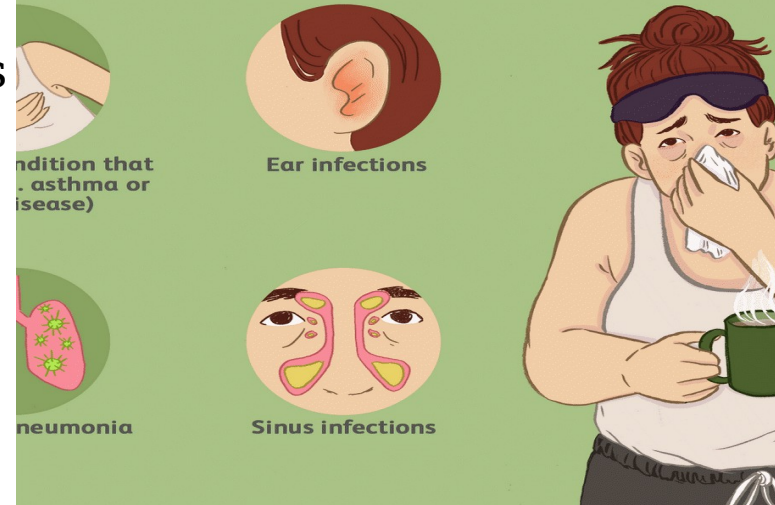
Treatment : Symptomatic

Symptoms of a cold:



ADAM.

Potential Complications From the Flu



Rhinoviruses



Structure

A-Family

Picorn (small RNA) famil

B-Nucleocapsid

- ss RNA
- **Icosahedral**

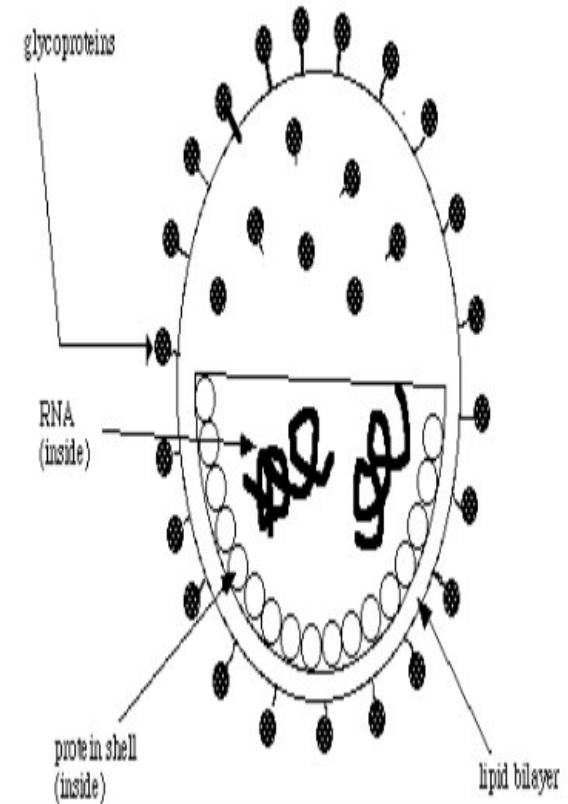
C - **Non** enveloped

D - **Classification**

Over 100 serotypes

Rhinovirus

- ▶ Picornoviridae family
- ▶ Size
- ▶ Single stranded
- ▶ Incubation period of 1 to 3 days
- ▶ Optimum growth occurs between 33 and 34 deg Celsius (93 deg F)
- ▶ Not stable below the pH of 5-6



▶ 9

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Rhinoviruses



Pathogenesis

Is the commonest cause of the common cold



A-Mode of transmission

1-Droplet

2-Contact

a-Direct : hand to hand contact followed by rubbing



b-Indirect : via objects as towels



(stable on the surface as it is nonenveloped)

Rhinoviruses



B- Site of viral replication

1-Replicate better at 33°C than at 37°C



Infection is limited to the mucosa of the

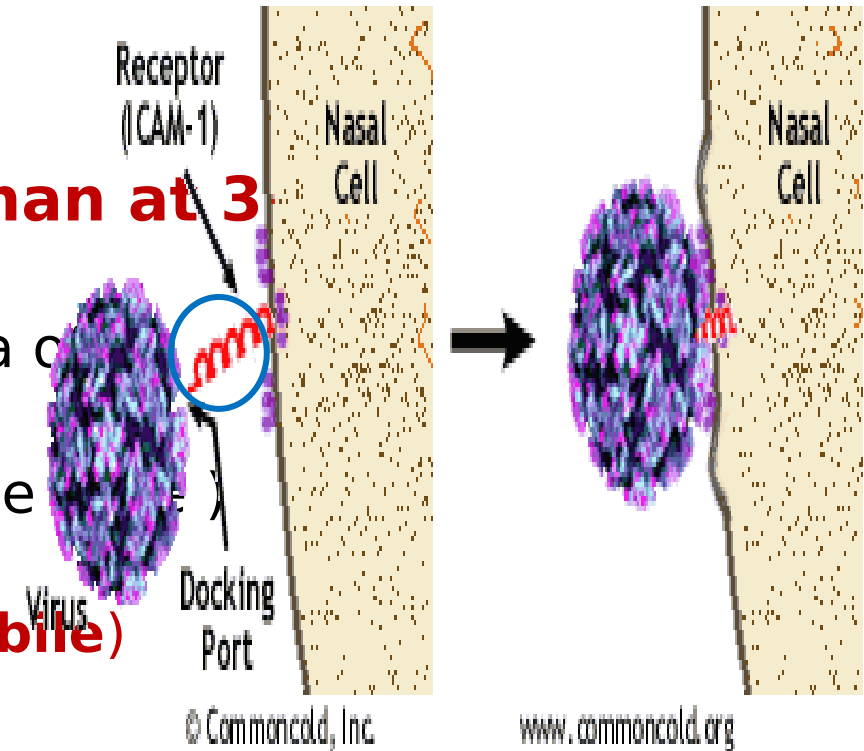
URT & conjunctiva (rhino = the nose)

2- Killed by gastric acid (acid-labile)



No GIT infection

3- Multiplies locally without blood invasion.



Rhinoviruses



C- Effect of replication

1-The virus attaches to cells of the nasal mucous membrane and repli



Infected cells lose their ciliary acti

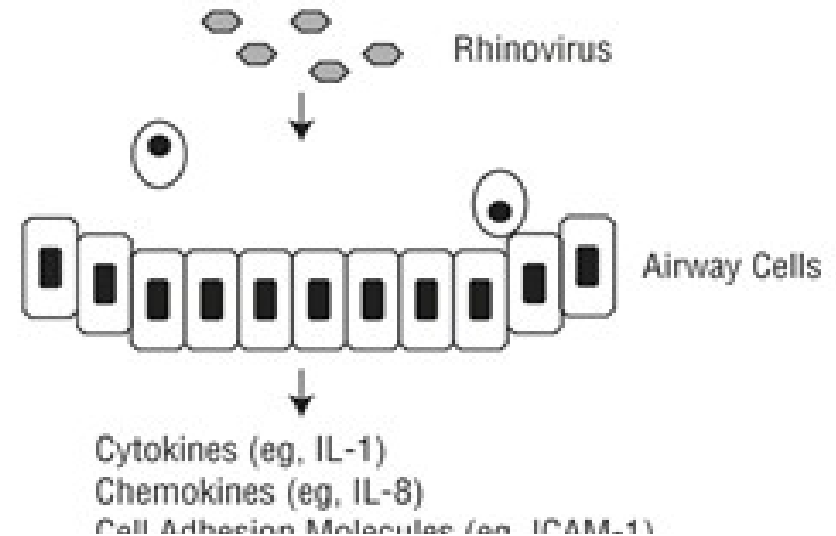
2-Release of inflammatory mediato



↑ mucus production

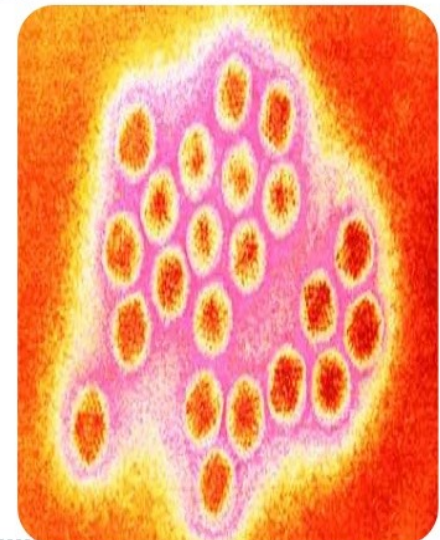


Nasal congestion



► Inflammatory cascade hypothesis:

Common cold symptoms result from an inflammatory cascade triggered by a



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Rhinoviruses



D-Immunity :Why repeated infection with Rhinoviruses is common?

1- Short lived immunity

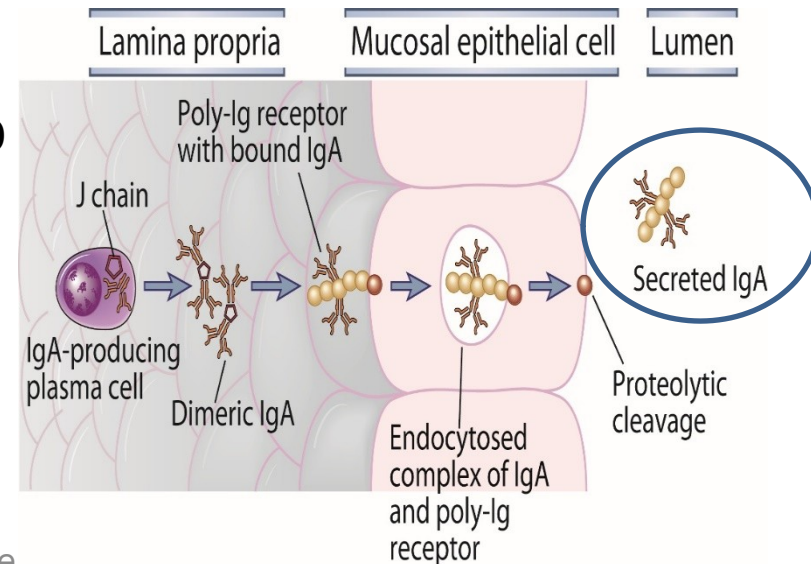
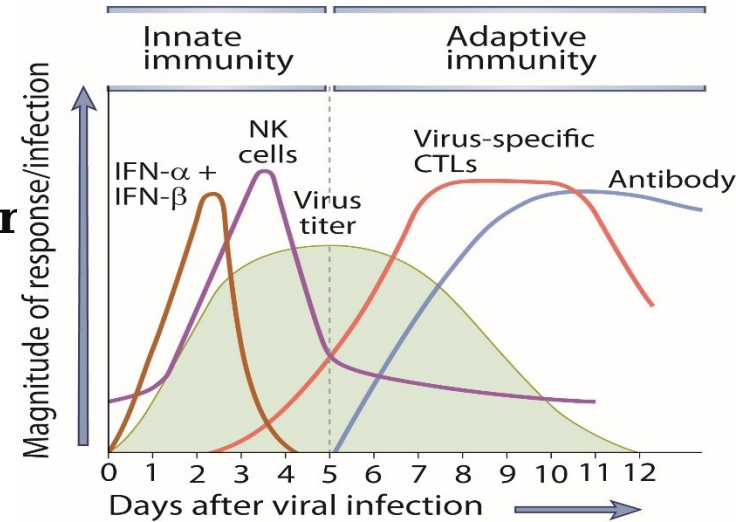
as it is mainly due to interferon α & nasal secretions rather than IgG antibody.

2-Type specific immunity



No cross protection

between the multiple antigenic types (> 100)



Rhinoviruses



Laboratory diagnosis

Usually not required (**clinically diagnosed**)

Prevention

Why It is hard to develop a vaccine for Rhinoviruses

(common cold) ?

**Vaccine
production
impractical**

Due to **multiplicity** of serotypes (>100) with **no cross protection**

Treatment

Symptomatic treatment.

Why antibiotics are not indicated for common cold ?

Thursday, December 14, 2017

Medical Microbiology & Immunology

Is caused by **virus not affected by antibiotics**



Lecture Quiz



Which statement is true about Rhinoviruses?

- a) Can be prevented by a live attenuated vaccine given yearly
- b) Causes serious infection of the upper and lower respiratory tract
- c) Cause the severe acute respiratory distress syndrome
- d) Infection provides long time immunity
- e) Replication occurs mainly in the nasal mucosa

e

II-PHARYNGITIS



70 % of acute sore throats are caused by viruses.

1. Adenoviruses (the most common)

2. Rhinoviruses

3. Others

a. Coxsackieviruses

b. Herpes simplex viruses 1

c. Epstein-Barr virus &

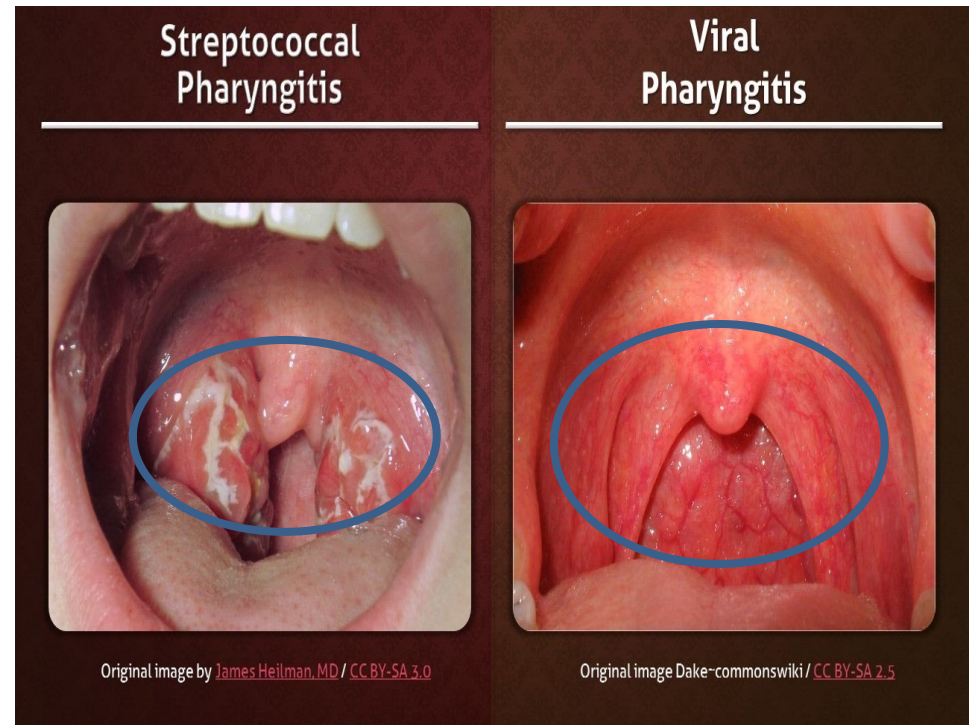
PHARYNGITIS



Clinical manifestations of viral pharyngitis

1. Fever
2. Sore throat
3. On examination:

**Inflamed pharynx, tonsils,
& palate**



I - Adenovirus



Structure

A-Nucleocapsid

1-ds DNA viruses

2-Icosahedral

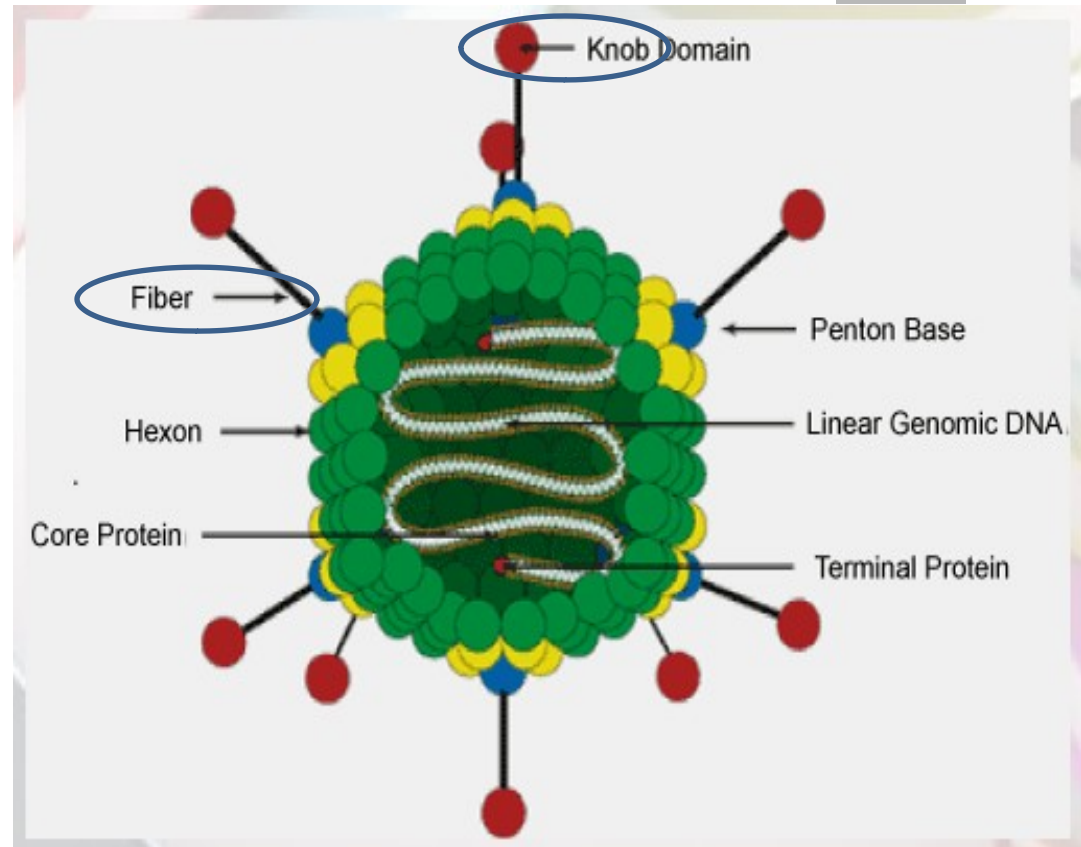
3-Capsid carries fibers

topped with knobs →

a-Attachment of virus

b-Type specific Ags (52 serotypes)

B - Non-enveloped



Pathogenesis

A-Mode of transmission

1-Droplet

2- Fecooral : commonest in children

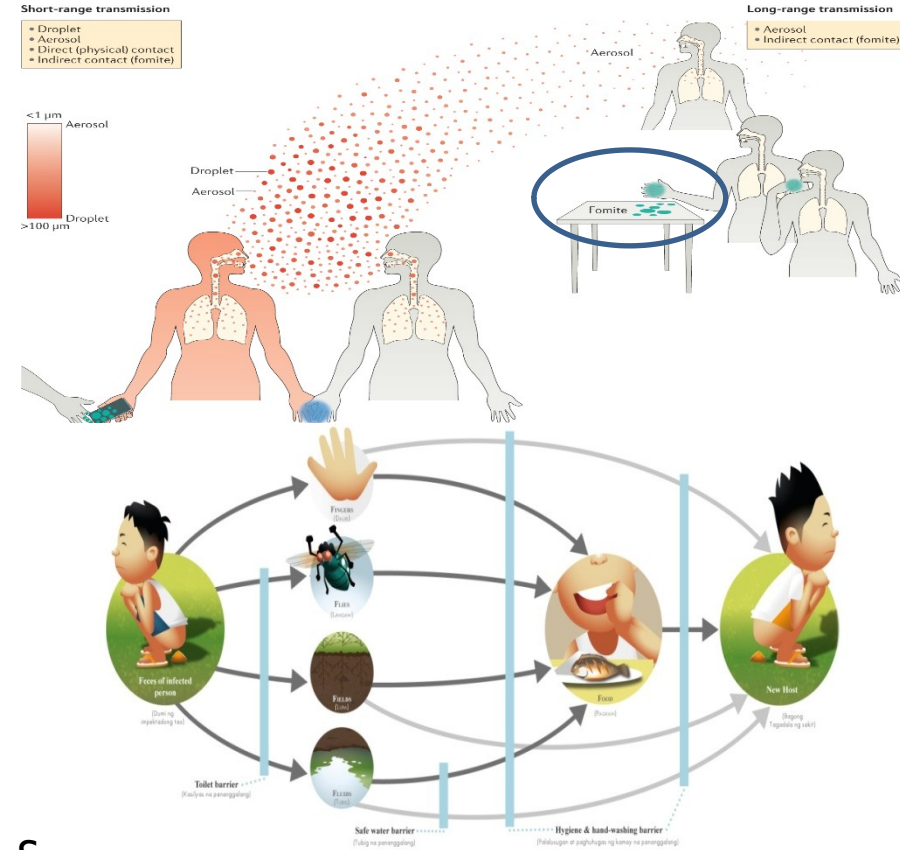
3-Direct inoculation of conjunctiva

By contaminated eye instruments or fingers

⊛ **Stable** to chemical or physical agents &

adverse pH conditions

Prolonged survival outside of the body



Pathogenesis

B- Acute infection → death of cells

The virus infects mucosal epithelium of several organs

e.g RT (upper & lower), GIT , conjunctiva & urinary tract

C- Latent infection

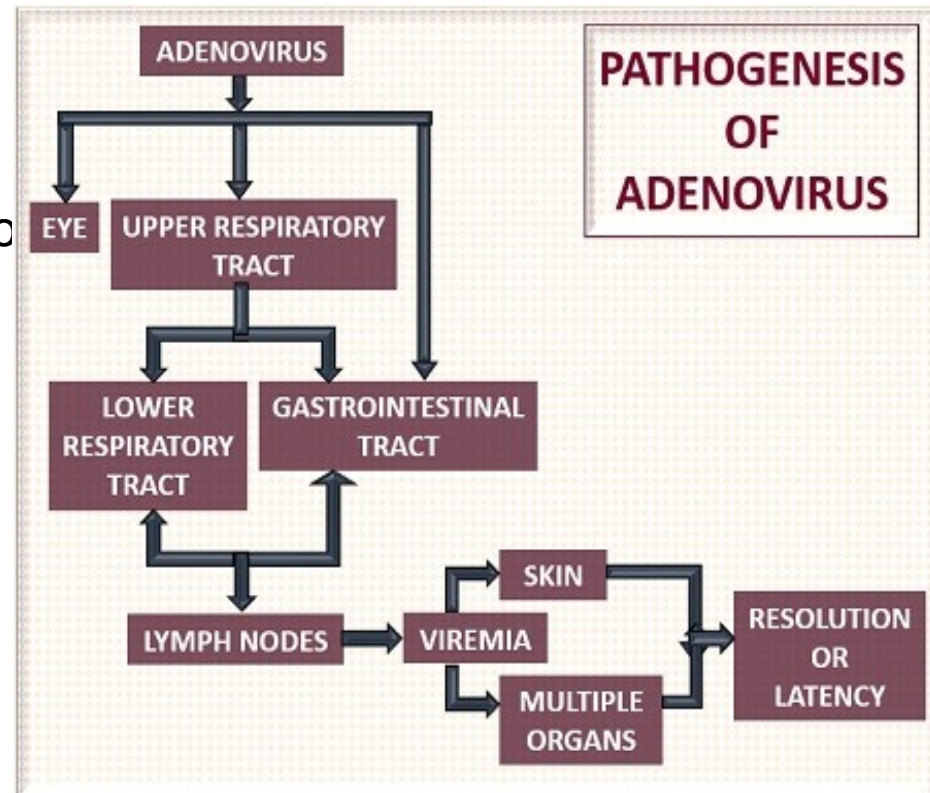
In adenoids (hence the name) & tonsils

D-Immunity

Induces **type specific neutralizing**



Lifelong immunity



I-Adenoviruses



Clinical manifestations

A- Respiratory tract infections (RTIs)

1-Pharyngitis

2-Pharyngoconjunctival fever

3- Acute respiratory disease (ARD).

- It is mainly observed in **military recruits**
- Fever, , running nose, cough, sore throat (pharyngitis)
- ⊙ May progress to **atypical pneumonia**
(rare, but fatal)



I-Adenoviruses



Clinical manifestations

B - Infantile diarrhea (see GIT infections)

C - Eye diseases

(see eye infections)

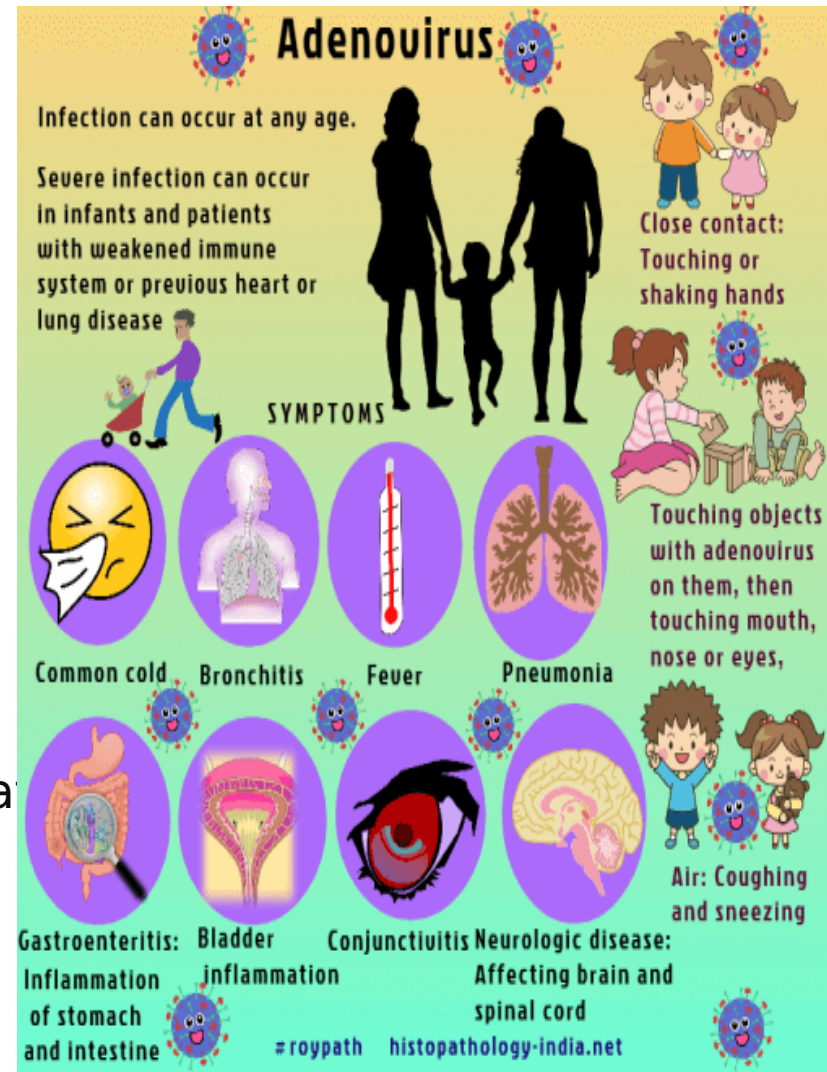
D - Hemorrhagic cystitis

In children : Hematuria & dysuria

E - Diseases in transplant recipients

1-Hepatitis : in liver transplantation

2-Pneumonia : in bone marrow transplantation



Laboratory diagnosis of Viral Infections

1 Direct demonstration of virus or its constituents in clinical specimens

▶ Serological detection of specific Abs: Most widely used method

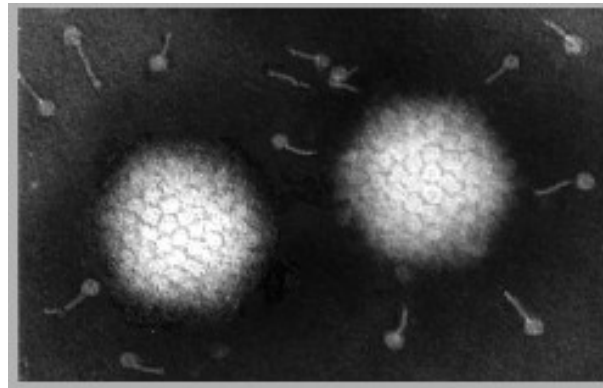
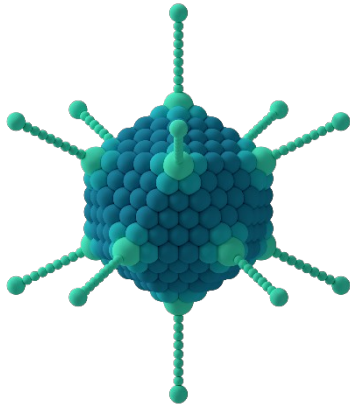
▶ Virus isolation on living cells

Laboratory diagnosis of Viral Infections

Direct demonstration of virus or its constituents in clinical specimens

1 Detection of viral particle by EM

For viruses of **special morphology** e.g Rota & Herpes viruses



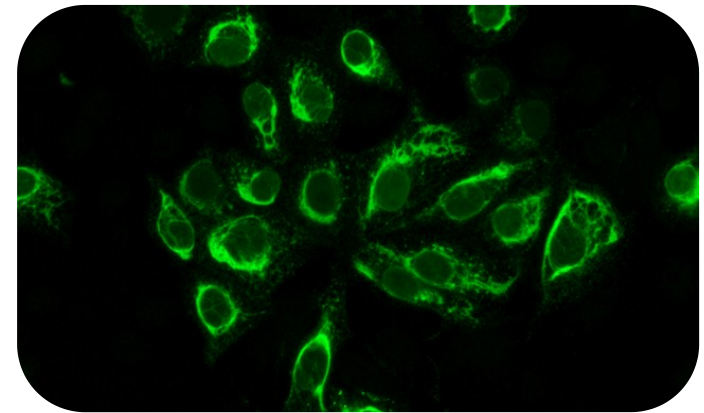
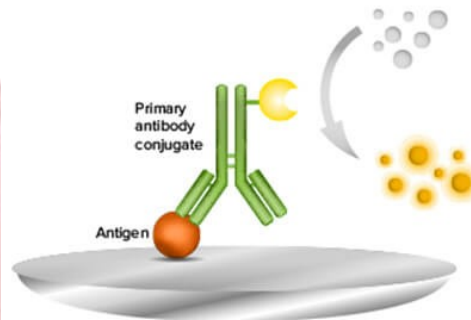
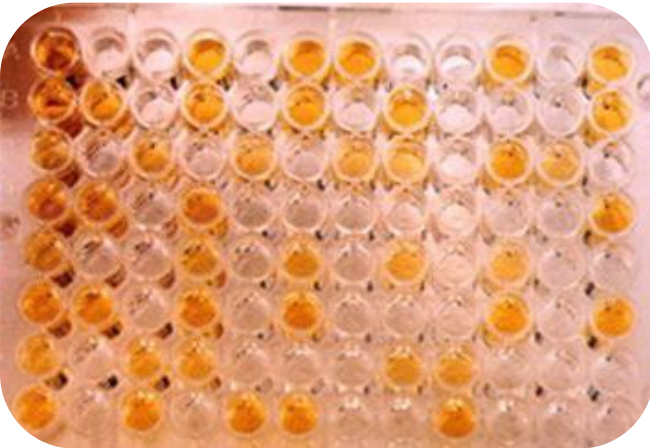
Laboratory diagnosis of Viral Infections

Direct demonstration of virus or its constituents in clinical specimens

2 Detection of specific Ag

■ ELISA

■ Immunofluorescence (IF)

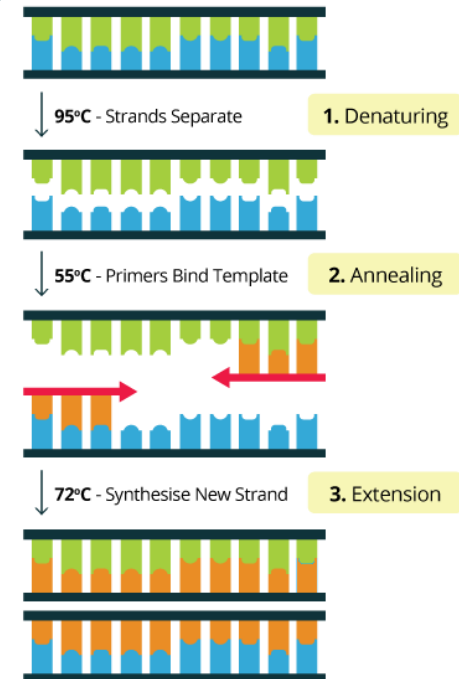


Laboratory diagnosis of Viral Infections

Direct demonstration of virus or its constituents in clinical specimens

3 Detection of viral genome (nucleic acid) by molecular techniques

Polymerase chain reaction (PCR): Highly **specific & sensitive** → Detects **minimal amount** of viral DNA & RNA

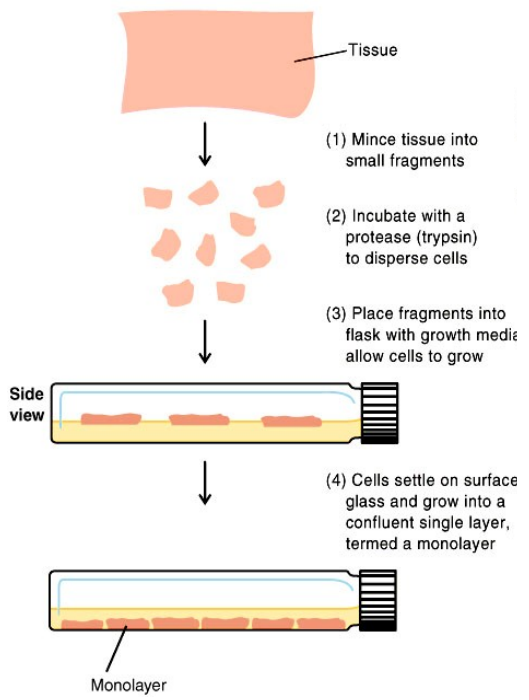


Virus isolation on living cells

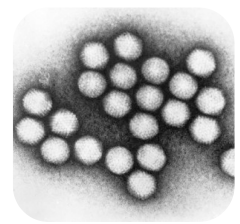
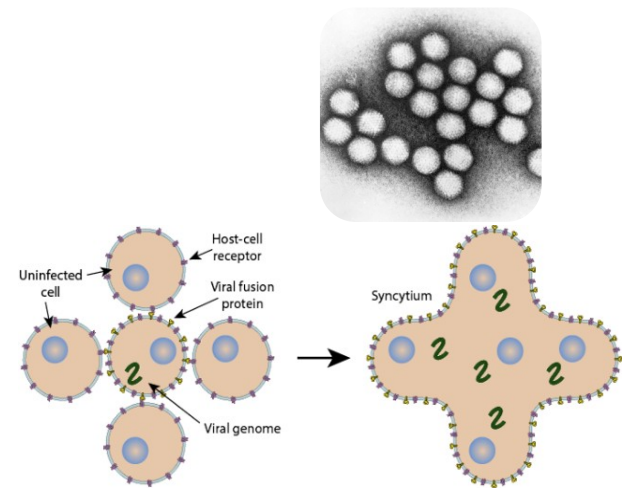
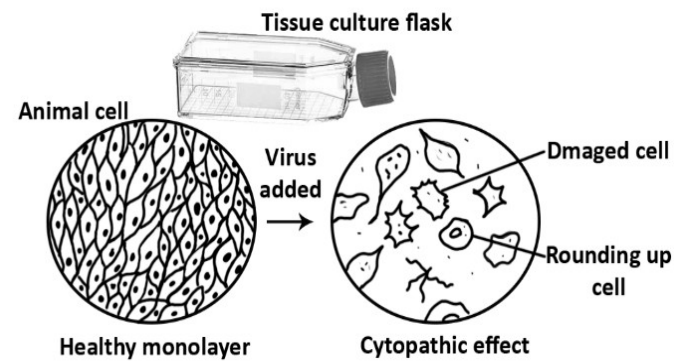
1 Tissue culture (TC)

No growth on bacterial culture
Inoculation of virus on **living cell culture** → **Viral growth is recognized by:**

A) Cytopathic effects (CPE):



- **Grape-like** cells e.g Adeno
- **Fusion** of cells → **Syncytia** (multinucleated giant cells) e.g RSV



Laboratory diagnosis of Viral Infections

▶ Serological detection of specific Abs: Most widely used method

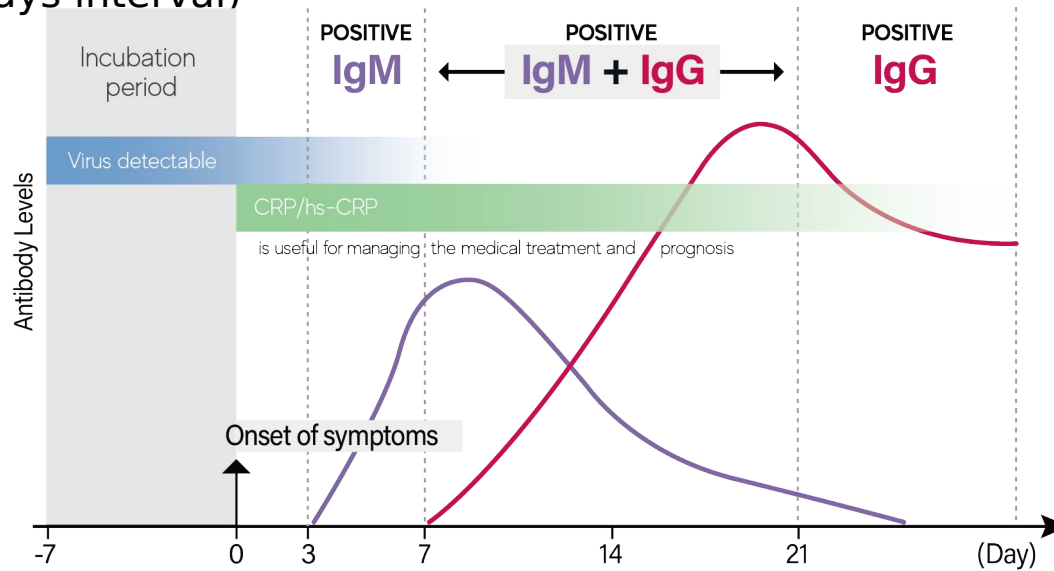
a) ELISA b) Immunofluorescence

1 **IgM** Appears **early** in infection → Diagnosis of **recent or acute infection**

2 **IgG** Appears **later**, persists **longer** → **Diagnosis of acute infection**

if **Rising titer 4 folds** in paired serum sample

(10 days interval)



I - Adenoviruses



Laboratory diagnosis

Specimen: Throat swab, sputum

1. Direct virus demonstration :

- a- E/M : detects viral particle
- b- Immunofluorescence : detects viral A
- c- PCR. : detects viral DNA

2. Virus isolation

CPE : grape like rounded cells

3. Serology

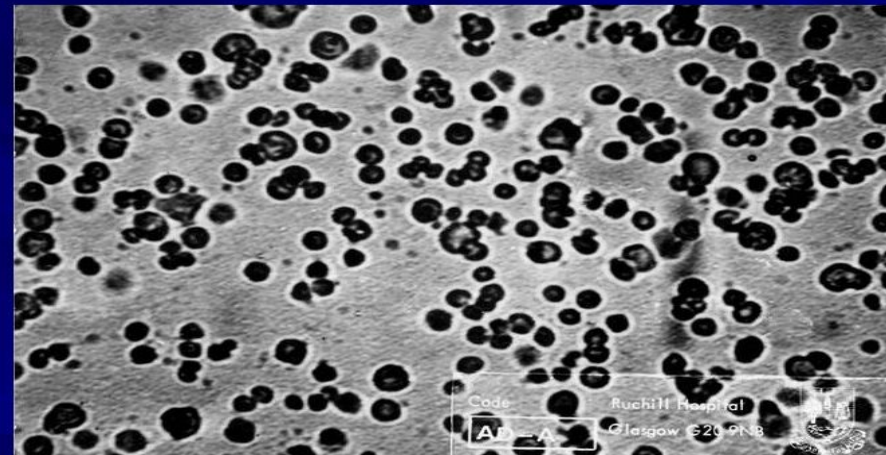
Detects rising titer of IgG

Lab Diagnosis

Direct detection:

- **Virus particle by EM** can be detected by direct examination of fecal extracts
- **Detection of adenoviral antigens by ELISA.**
Enteric Adenoviruses
- **Detection of adenoviral NA by Polymerase chain reaction:** can be used for diagnosis of Adenovirus infections in tissue samples or body fluids.

Adenovirus CPE



I - ADENOVIRUSES



Prevention by active immunization : Vaccine

A-Type

⊛ Three live, non-attenuated vaccines against serotypes 4, 7, and 21

■ Taken orally in an **enteric-coated capsule**

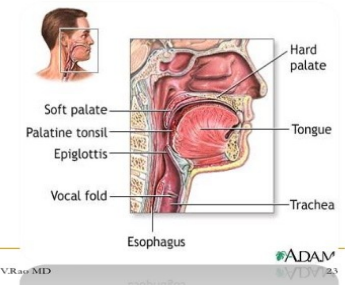


Protects the live virus from inactivation

by stomach acid.

ARD – Acute respiratory disease with Adenovirus

- Occurs usually in military recruits
- Serotypes 4,7, and 21 are agents commonly associated.



B-Effect

The virus infects the gastrointestinal tract



Asymptomatic infection and

induces immunity to respiratory disease

C-Indication :

Used **only by the military.**



Suggested textbooks



- ***Review of Medical Microbiology and Immunology, Warren Levinson***
 - from page 1350 - 1365

